

WHAT IS CLAIMED IS:

1 1. A system for applying a plurality of reactive fluids to a remote
2 application site at controlled rates without premature reaction, said system comprising:
3 a plurality of reservoirs, each reservoir to retain one of said reactive fluids, and each
4 said reservoir having an independent exit line for discharge of the contents of
5 said reservoir;
6 a crescent internal gear pump on each of said independent exit lines to produce an
7 independent flowing stream at a selected flow rate for each of said reactive
8 fluids, respectively;
9 mass flow rate measuring means for continuously measuring mass flow rates of each
10 independent flowing stream and for generating an independent signal
11 representative of each mass flow rate thus measured;
12 a single automatic controller receiving all of said independent signals, comparing said
13 signals with a target, and governing the speed of each crescent internal gear
14 pump to correct deviations from said target;
15 transport means for separately receiving output flows of said crescent internal gear
16 pumps, separately transporting said output flows to said remote application
17 site, and combining said output flows at said remote application site; and
18 application means for dispensing said combined output flows at said remote
19 application site.

1 2. A system in accordance with claim 1 in which said mass flow rate
2 measuring means comprise a plurality of individual Coriolis-type mass flowmeters, one such
3 flowmeter installed on each of said exit lines.

1 3. A system in accordance with claim 1 in which each of said exit lines
2 comprises a recirculation loop and a bleed stream drawing reactive fluid from said
3 recirculation loop, and each said crescent internal gear pump is mounted on said bleed
4 stream.

1 4. A system in accordance with claim 1 further comprising a plurality of
2 independent variable frequency drive motors, one said motor driving each of said crescent
3 internal gear pumps, said controller governing the speeds of said crescent internal gear pumps
4 by adjusting the frequencies of said variable frequency drive motors.

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- 1 **5.** A system in accordance with claim 1 in which said mass flow rate
2 measuring means are positioned upstream of said crescent internal gear pumps.
- 1 **6.** A system in accordance with claim 1 in which said transport means
2 comprises a multi-lumen cable with individual lumens for each of said output flows.
- 1 **7.** A system in accordance with claim 1 in which said crescent internal
2 gear pumps each have a continuous rated pressure of from about 2,000 psi to about 6,000 psi
3 and peak pressures of from about 3,000 psi to about 5,000 psi.
- 1 **8.** A system in accordance with claim 1 further comprising traction means
2 for drawing said transport means through an underground pipe.
- 1 **9.** A system in accordance with claim 1 in which said reservoirs are
2 temperature-controlled.
- 1 **10.** A system in accordance with claim 6 in which said reservoirs and said
2 multi-lumen cable are temperature-controlled.
- 1 **11.** A system in accordance with claim 6 in which said multi-lumen cable
2 further comprises water circulation lumens for temperature control of other fluids passing
3 through said multi-lumen cable.
- 1 **12.** A system in accordance with claim 1 further comprising a trolley
2 configured to support said application means inside a pipe in a manner maintaining said
3 application means axially aligned with said pipe while permitting movement of said
4 application means axially through said pipe.
- 1 **13.** A system in accordance with claim 6 further comprising mixer means
2 between said multi-lumen cable and said application means.
- 1 **14.** A system in accordance with claim 1 in which said application means
2 is a spray nozzle.
- 1 **15.** A method for applying a plurality of reactive fluids to a remote
2 application site at controlled rates without premature reaction, said method comprising:

- (a) independently pumping said reactive fluids to said remote application site by use of an individual crescent internal gear pump for each said reactive fluid, said pumps operating at a speeds controlled by a control loop comprising
 - (i) a plurality of mass flowmeters, one measuring the mass flow rate of each of said reactive fluids;
 - (ii) a plurality of a variable frequency pump drives, one driving each of said crescent internal gear pumps; and
 - (ii) an automatic controller receiving input signals from all of said mass flowmeters, comparing said input signals with a preselected relationship among mass flow rates for all of said reactive fluids, and emitting output signals representative of differences between said input signals and said preselected relationship, and
- (b) combining said reactive fluids at said remote application site and dispensing said combined reactive fluids at said remote application site.

16. A method in accordance with claim **15** in which said mass flowmeters are Coriolis-type mass flowmeters.

17. A method in accordance with claim **15** in which step (a) comprises conveying said reactive fluids thus pumped to said remote application site through individual lumens of a temperature-controlled multi-lumen cable.

18. A method in accordance with claim **17** in which temperature control of said temperature-controlled multi-lumen cable is achieved by circulating heated heat transfer fluid through said multi-lumen cable.

19. A method in accordance with claim **15** in which step (a) comprises pumping said reactive fluids at flow rates of from about 1 cubic meter per hour to about 150 cubic meters per hour.

20. A method in accordance with claim **15** in which step (a) comprises pumping said reactive fluids at flow rates of from about 3 cubic meters per hour to about 50 cubic meters per hour.

21. A method in accordance with claim **15** in which said remote application site is the interior of a pipe, step (b) comprises dispensing said combined reactive

3 fluids to said pipe interior by a movable application head, and said method further comprises
4 drawing said movable application head along the axis of said pipe at a controlled velocity.

1 **22.** A method in accordance with claim **15** in which said reactive fluids are
2 individual components of a two-component epoxy.

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